



Reducing Emissions from Small Off-Road Engines: Operator Exposure, Health Risks, and Pathways to Zero Emissions

November 15, 2018

Small Off-Road Engines (SORE)



SORE Emission Sources



Exhaust emissions:
in operation



Evaporative emissions:
while stored

SORE Regulatory History

2003: Evaporative standards

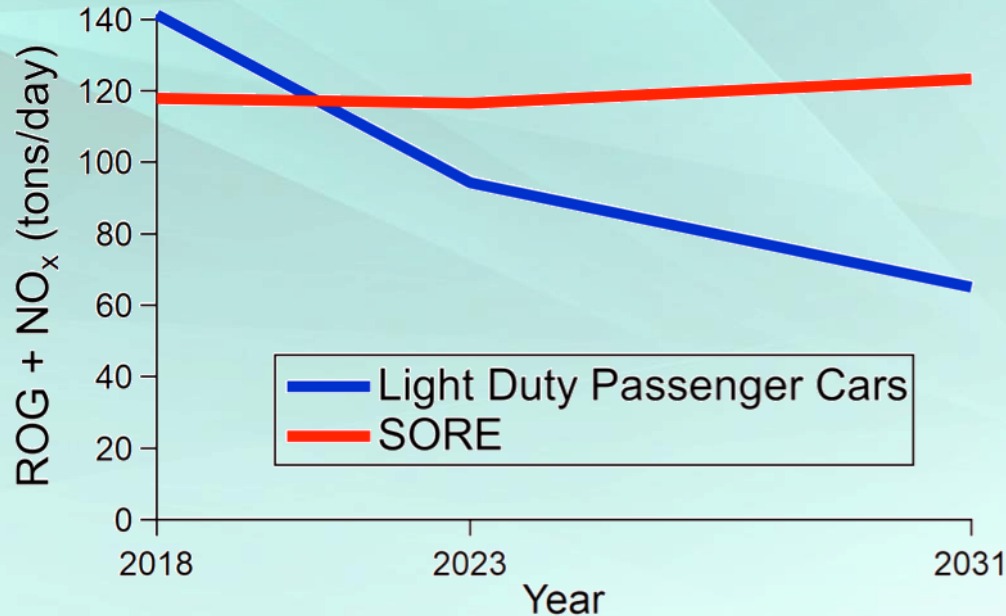
2016: Evaporative amendments

1990: First SORE exhaust standards adopted

2008: Zero-emission credits

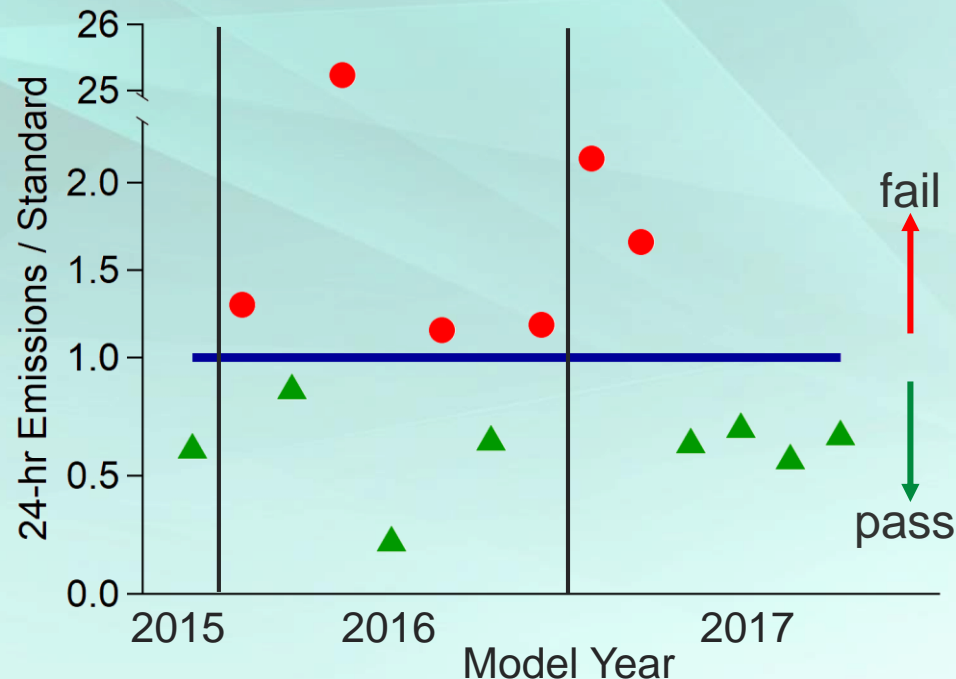
2020: New regulatory amendments for lower emissions standards

SORE Emissions Surpass Cars



- Evaporative and exhaust emissions
- Emissions from SORE will exceed cars near 2020
- Increase in emissions due to increasing SORE population

Compliance Rates Unchanged



- Evaporative emissions testing
- 14 families (70 engines) tested to date
- Overall, ~42% of engines have failed

What are the Health Risks?

- Operators may be subjected to elevated exhaust exposure
- Few studies on exposures and health impacts for operators
- Study to estimate exposures and health risks from air toxics, particles, CO, and noise



Devices Tested

New, used gasoline and new electric devices tested

Chainsaw



Leaf blower



String trimmer



Hedge trimmer



Push mower



Riding mower

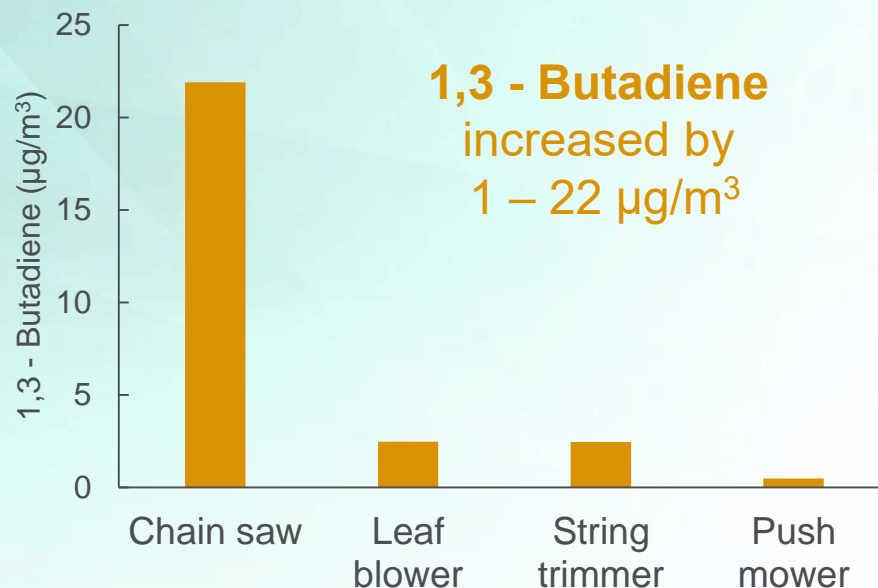
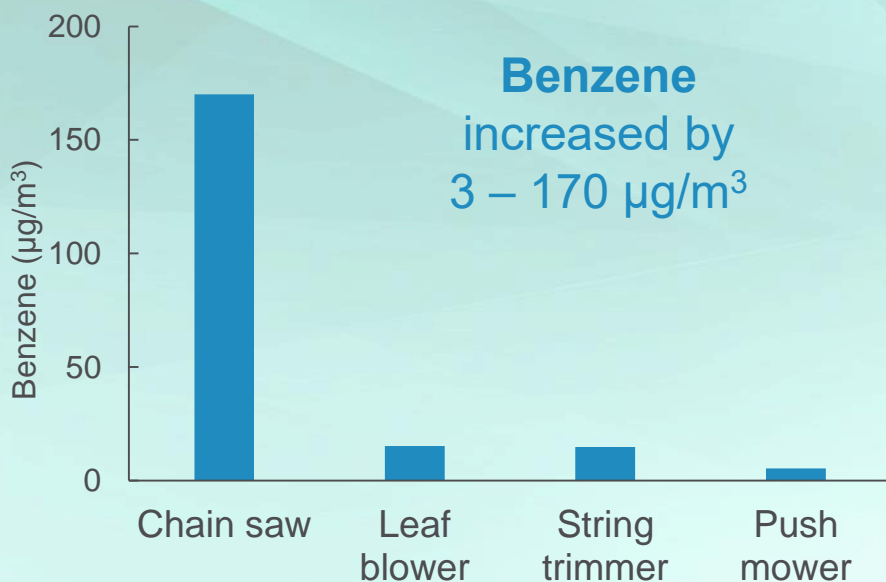


A Toxic Plume for Operators



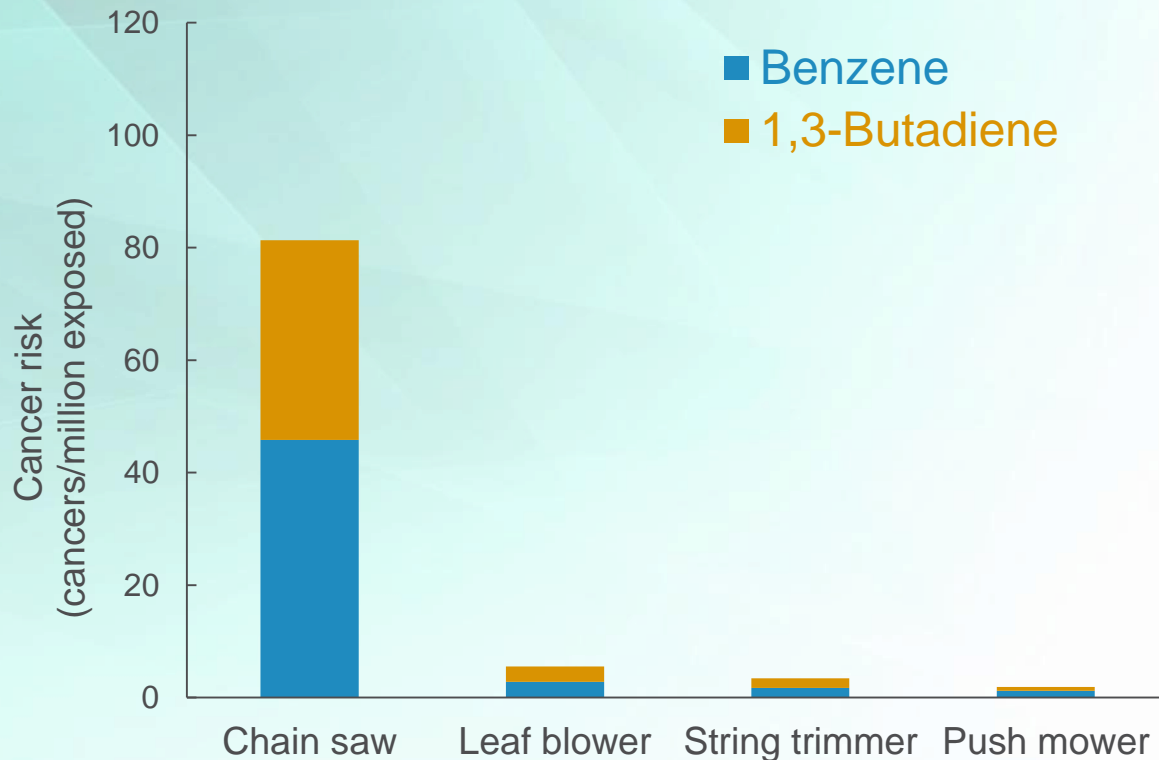
Increased Air Toxics Exposure

Elevated exposures to two carcinogens for all gasoline-powered devices



Increased Potential Cancer Risks

- All gasoline devices increased potential cancer risks
- Chainsaws produced the highest risks



Moving to Zero-Emission Technology Reduces Health Risks

- Lower exposures to toxic air pollutants
- Decreased cancer risks
- Lower exposures to CO and noise
- Reduced health risks



Zero-Emission Equipment

- Zero-Emission Equipment (ZEE) is available for all landscaping applications
- More than 45 brands of ZEE on the market
- 12 ZEE brands target landscape professionals



Capitol Park—Case Study



Coordinated demos of ZEE from several manufacturers

Enough power to do job... People need to embrace the change to electric.

Plenty of power to get work done.

Useful for times of high tourist traffic, as electric is much quieter

Demos Lead to ZEE Use



Capitol Park Grounds Crew:

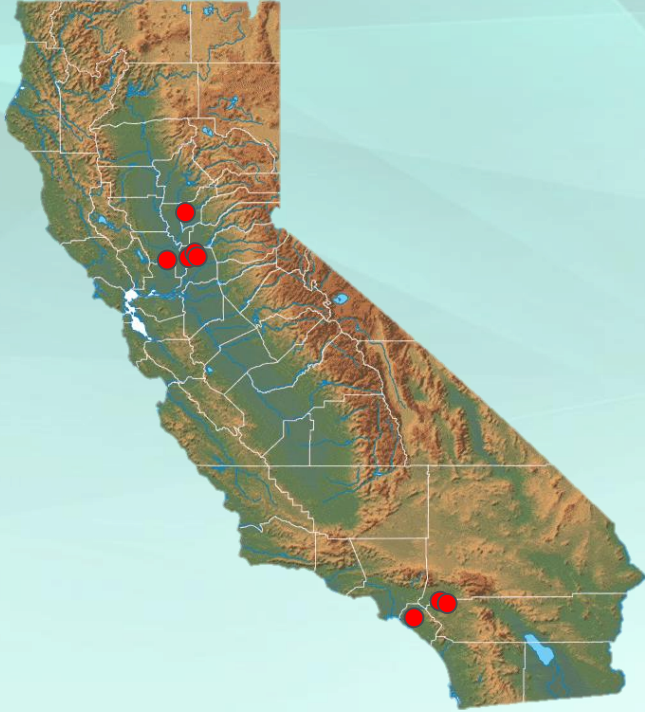
- Use electric equipment about half the time
- Have purchased over 10 pieces of ZEE

Working with Local Universities

- CSU Sacramento has tested several brands of ZEE
- CSU Sac and UC Davis each have a robotic mower demo



Expanding Statewide



- Cal DOT- Northgate and Marysville
- Riverside County
- DGS Riverside

Easiest transition to ZEE for groups that:

- Work in one location
- Maintain manicured grounds

ZEE Roadshow

- Contains 5 brands of commercial grade ZEE
- Visited Green Schools Conference, Irvine EV showcase
- Will leave equipment for 1-2 weeks

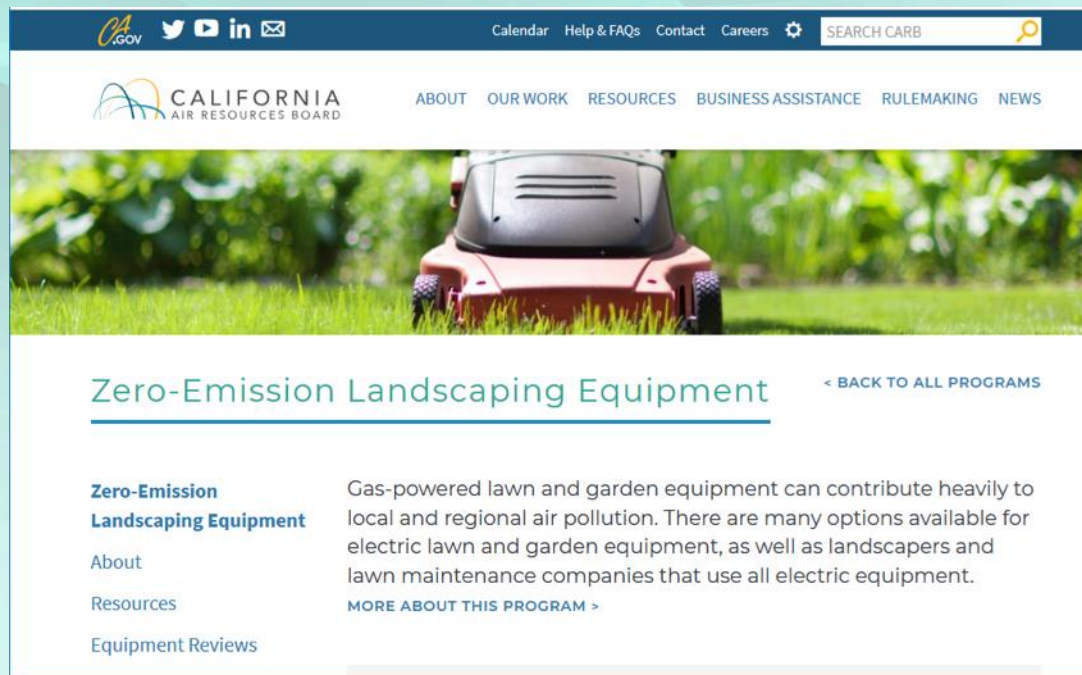


Leading by Example

- Working with GovOps and DGS to update SAM language
- Required to use ZEE first for exterior maintenance and landscaping

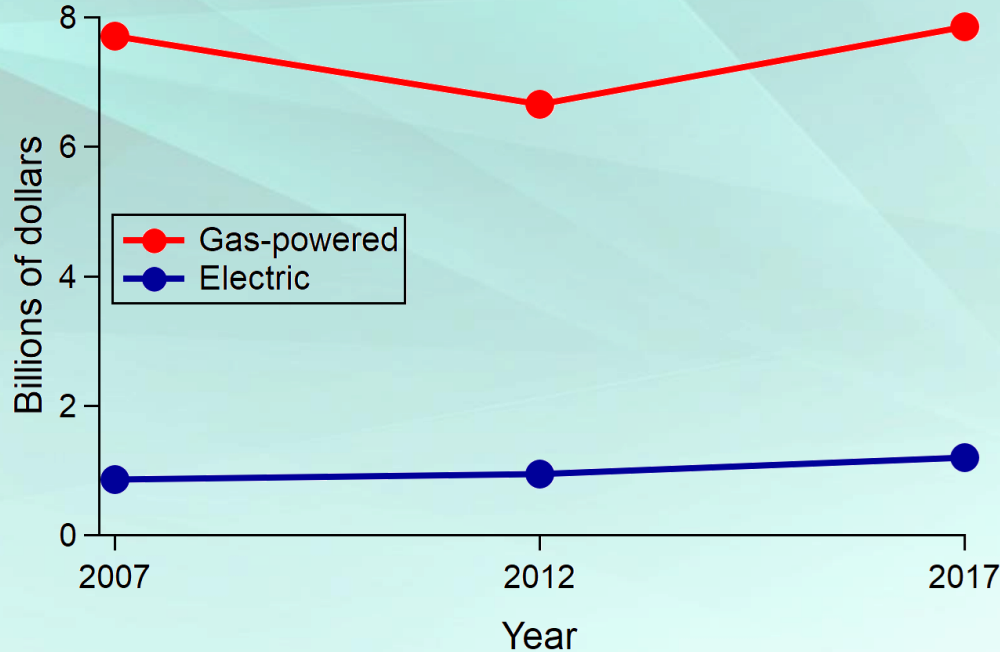


Online ZEE Directory



- Recently launched website
- Lists of ZEE available
- Directory of zero-emission landscapers

National Sales Trends



- Electric is slowly increasing percent of sales
- Electric sales have increased nearly 40% since 2007
- Data from Sept. 2018 Freedonia Group report

ZEE Break-Even Point

	Mean Green CXR60	TORO 3000 series
Power source	Battery	Gasoline
Cost	\$22,495	\$9,500
Annual electric or gas cost	\$3,429	\$7,965
Break-even point	< 3 years	



Bay Area AQMD Exchange Program



Dirty In

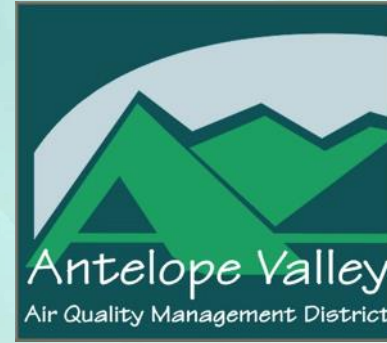


Clean Out



- Financed with settlement funds
- For school districts and municipal agencies
- Alameda and Contra Costa counties

Residential Exchange Programs



BAY AREA
AIR QUALITY
MANAGEMENT
DISTRICT



San Joaquin Valley
AIR POLLUTION CONTROL DISTRICT

Cities Moving to ZEE



- Ojai
 - All electric landscaping
- South Pasadena
 - “Green Zone City”



Schools Moving to ZEE

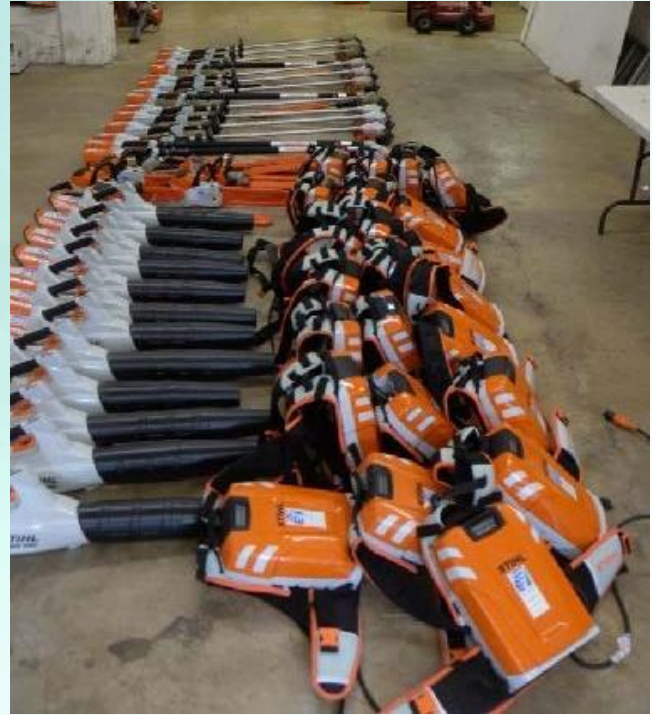


- California Green Schools Movement



Current Incentive Opportunities

- Clean Mobility in Schools Pilot Projects
- Moyer and AB 617
- Supplemental Environmental Projects



Small Business Support

- Focus on small landscaping businesses
- Can transform sector with relatively small investment



Pathway to 100% ZEE

- Significantly lower emission standards for SORE
- Category-specific ZEE requirements
- Expanded/new incentives for ZEE



Next Steps

- Return in 2020 with lower emissions standards
- Continue demonstrations through Roadshow and collaborations with manufacturers
- Implement incentive programs

